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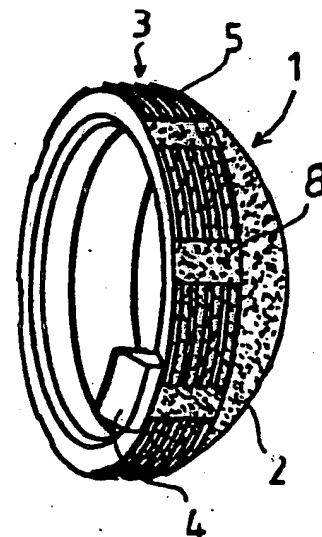
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/SE94/01233</p> <p>(22) International Filing Date: 21 December 1994 (21.12.94)</p> <p>(30) Priority Data: 9304281-0 23 December 1993 (23.12.93) SE</p> <p>(71) Applicant (for all designated States except US): ASTRA AKTIEBOLAG [SE/SE]; S-151 85 Södertälje (SE).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): ALBREKTSSON, Björn [SE/SE]; Barkassvägen 53, S-439 35 Onsala (SE). CARLSSON, Lars [SE/SE]; S:a Bergavägen 8, S-430 41 Kullavik (SE). JACOBSSON, Magnus [SE/SE]; Skärsgatan 37, S-412 69 Göteborg (SE). RÖSTLUND, Tord [SE/SE]; Fasanstigen 2, S-430 41 Kullavik (SE). WENNBERG, Stig [SE/SE]; P1 6266, S-424 57 Angered (SE).</p> <p>(74) Agent: ASTRA AKTIEBOLAG; Patent Dept., S-151 85 Södertälje (SE).</p>	<p>(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ).</p> <p>Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>	

(54) Title: **CUP**

(57) Abstract

The invention relates to a cup-shaped member for a hip joint prosthesis, for implantation into a cavity in the bone tissue in the acetabulum, comprising an acetabular cup (1) made of metal, a ceramic material or any other suitable material, preferably of titanium, the outside of said cup being rotationally symmetrical around a central axis of symmetry. The outer side of the cup (1), that is the side which is to face the bone tissue, is provided with at least one circumferential bead (5) close to the edge of the cup (1), said bead (5) having a barb-like shape in section and consequently allowing the cup (1) to be pushed into said cavity but counteracting the removal of said cup (1) from said cavity, said outer side including said bead(s) (5) being provided with a rough structure serving as a file when said cup (1) is moved or rotated in said cavity.



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Cup5 **Technical field of the invention**

The present invention relates to a cup-shaped member for a hip joint prosthesis for implantation into a cavity in the bone tissue in the acetabulum, comprising
10 an acetabular cup made of metal, a ceramic or any other suitable material, preferably of titanium, the outside of said cup to be implanted in the bone tissue being rotationally symmetrical around a central axis of symmetry.

15 **Background to the invention**

Artificial hip joints have been used and implanted into humans for a long period of time. The joints normally
20 comprise one femoral part which is intended to be inserted or implanted into the femur and which carries a ball-shaped articulation element, normally made of metal or a ceramic material. The joint further normally comprises a cup-shaped member, i. e. an acetabular cup,
25 which is to be inserted into or attached to the acetabulum, and which is to hold a complementary, cup-shaped liner, normally made of Ultra High Molecular Weight Polyethylene (UHMWPE) or a similar polymer material, in which the ball-shaped element is to
30 articulate or rotate.

The depth of the bone tissue which is available in the acetabulum for attaching the acetabular cup is limited in most directions. The acetabular cup per se is
35 furthermore rather flat and shallow, which means that the cup at least to some extent may be considered to be more or less placed directly onto the surface of the

bone tissue and not into the bone tissue, this in contrast to most other commonly used bone implants, such as screw-shaped dental implants or standard femoral implants. These factors make it difficult to design an acetabular cup that easily will be attached to the bone tissue by means of the shape of the cup or to design efficient attachment means for the cup.

Some prior art acetabular cups are disclosed in for instance DE-A-24 54 635, DE-A-26 45 101, US-A-3,903,549 and US-A-4,795,470.

A metal which is commonly used in bone implants is titanium because of its proven affinity with bone tissue and its good biocompatibility. One particular property of titanium is its tendency to form a close connection with bone tissue. The formation of this close connection is often termed "osseointegration". One factor which may be important for a proper osseointegration process is a relatively good fit between implant and bone tissue, another a relative immobility between implant and bone tissue.

The object of the present invention is to provide an acetabular cup which provides conditions favourable to the osseointegration process by influencing the factors described above and which consequently provides a cup which will be firmly attached to the bone tissue.

Brief description of the inventive concept.

This object is achieved in that the outer side of the cup, that is the side which is to face the bone tissue, is provided with at least one circumferentially oriented bead close to the edge of the cup-shaped element, said bead having a barb-like shape in section and consequently allowing the cup-shaped element to be

pushed into said cavity but counter-acting the removal of said cup-shaped element from said cavity, said outer side including said bead(s) being provided with a rough structure serving as a file or saw when said cup is pushed and/or rotated into said cavity.

Further advantageous embodiments are set forth in the dependent claims.

10 Short description of the appended drawings

Fig 1 shows a side view of an acetabular cup according to the invention.

Fig 2 shows a view of the cup of Fig 1

15 Fig 3 a section along the line III-III in

Fig 2, and

Fig 4 shows a perspective view of the cup and Fig 5 details of the thread.

20 Detailed description of a preferred embodiment of the invention

In this preferred embodiment the cup-shaped member comprises an acetabular cup 1 which is shown in detail in figs 1-3. The cup 1 is intended to hold a complementary liner which may be attached to the cup according to any standard procedure or by any standard means.

30 The cup comprises two main parts, one spherical segment 2 and a cylindrical part 3 adjoining the edge of the spherical segment. The outside of the cylindrical part 3 is provided with a circumferential bead which is in the form of a thread 5. The forward side or flank 6 of the thread 5 forms an acute angle with the surface of the cylindrical part of the cup, i.e. the longitudinal orientation there of, whereas the backward edge or flank

7 is more or less perpendicular to said surface of the cup. The pitch D of the thread may be about 2 mm and the height H about 1 mm in a normal sized cup. In this way the thread in section will have the shape of a barb or a saw tooth. When the cup is pushed into a cavity in the bone tissue, the thread consequently will allow the cup to be moved into the cavity but will prevent the cup to be moved out from the cavity.

10 The threads do not have to run around the entire periphery of the cylindrical part 3 and may for instance be broken by means of axial gaps 8 spaced equidistantly around the periphery.

15 The entire outer surface of the cup, including the cylindrical part 3 and the threads 5, is roughened. The rough structure should have relatively sharp edges so as to be able to function in a manner similar to a file. A suitable way of obtaining this roughness is by 20 blasting the surface with Al_2O_3 having a particle size of about 0,25 mm at a pressure of 3 - 6 bar. It is also conceivable to use particles of TiO_2 .

The free edge of the cylindrical part is also provided with a projecting lug 4, which may be used to lock the 25 liner against rotation in the cup when the hip joint prosthesis actually is in use and the above-mentioned ball-shaped member on the femoral part of the prosthesis moves in the liner.

30 When the cup is to be mounted, a cavity is cut in the bone tissue in the acetabulum. The shape of this cavity corresponds closely to the outer surface of the cup apart from the threads. The diameter of the cavity preferably is about 1 mm smaller than the diameter of 35 the core part of the cylindrical part of the cup, i. e.

about 1 mm smaller than the diameter as measured from the tips of the threads 5. The cup is then gently tapped as far into the cavity as possible. The cup will now be held in the cavity by means of the threads, which will be pressed into the walls of the cavity. The inward movement of the cup in the cavity will result in that the roughness on the exterior of the cup will act as a file, to some extent shaping the cavity after the shape of the cup. Some scraped-off bone tissue will also be deposited into the roughness.

The cup now may be turned, for instance a quarter of a turn in the cavity by means of a tool engaging the lug 4. This rotation of the cup has four important aspects, which each one is important per se, but which are most advantageous in combination.

The first aspect is that the rough structure on the surface again will act as a file on the inner surface of the cavity and thereby, if necessary, shape the cavity to conform exactly to the shape of the cup.

The second aspect is that the thread, which also will act as a file, will cut an inner thread on the inner surface of the cavity, by which means the cup will be held still more securely. The scraped-off bone tissue will be collected in the irregularities on the surface in both these cases.

The third aspect is that the cup will be screwed inwards by into the cavity by means of the threads which are being cut, which means that the cup will be pressed inwards against the surface of the cavity.

The fourth aspect is that, as mentioned above, the irregularities on the surface will be filled with

scraped off bone tissue which will promote the growth of newly formed bone tissue into the irregularities.

5 The cylindrical part of the cup will tend to stabilize the cup in the cavity since it will counteract any tendencies of the cup to rotate out of the cavity by a lateral sliding movement along the respective spherical surfaces of cup and cavity. The cylindrical part will also offer a larger attachment area along the edge of the cup, i. e. that part at which the forces from the bone tissue being a result from the fact that the cup is forced into the cavity are oriented perpendicularly relative to the axis of symmetry of the cup.

10 The threads on the exterior of the cylindrical part of the cup have the advantage that the cup easily may be unscrewed without damaging the cavity in the acetabulum, should the cup happen to be canted during the insertion process.

20 The invention of course can be varied in many ways within the scope of the appended claims. It should for instance be noted that the beads or threads do not have to be unbroken around the entire periphery of the cup and may for instance be in the form of one or several series of relatively short sections.

25 The roughness on the outer surface of the cup of course can be obtained in any suitable way resulting in relatively sharp-edged irregularities. Alternative methods might for instance be etching, mechanical scoring or cutting and possibly plasmaspraying. The roughness on the surface also could be obtained by providing the surface with a rough layer of some other material than the material in the cup, such as a plasmaprayed layer of hydroxy-apatite. The additional layer advantageously might be an osseointegration

5 The cup of course also can be provided with additional fastening means, such as holes for bone screws, should the prevailing conditions be such as to require this.

The cup can be provided with other suitable tool-engaging means for the rotation of the cup than the lug described in the preferred embodiment. It should also be noted that the quarter turn of the cup described in connection with the preferred embodiment is only given as an example and that other rotation angles are

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CLAIMS

1. Cup-shaped member for a hip joint prosthesis, for implantation into a cavity in the bone tissue in the acetabulum, comprising an acetabular cup (1) made of metal, a ceramic material or any other suitable material, preferably of titanium, the outside of said cup to be located in the bone tissue being rotationally symmetrical around a central axis of symmetry, characterized in that the outer side of the cup (1), that is the side which is to face the bone tissue, is provided with at least one circumferentially oriented bead (5) close to the edge of the cup (1), said bead (5) having a barb-like shape in section and consequently allowing said cup (1) to be pushed into said cavity but counter-acting the removal of said cup (1) from said cavity, said outer side including said bead(s) (5) being provided with a rough structure serving as a file when said cup (1) is moved or rotated in said cavity.
2. Cup according to claim 1, characterized in the forward edge (6) of said barb-shaped bead (5) forms an acute angle with the surface of said cup (1) and in that the backward edge (6) is substantially perpendicular to said surface.
3. Cup according to claim 1 or 2, characterized in that said outer side is blasted in order to obtain said roughness, for instance by means of particles of TiO_2 or of Al_2O_3 .
4. Cup according to anyone of claims 1 - 3, characterized in that said circumferential bead (5) is in the form of at least one thread.

5. Cup according to anyone of claims 1 - 4, characterized in that said beads (5) or threads are located on a cylindrical part (3) of said cup (1).

5

6. Cup according to any one of the preceding claims, characterized in that said beads are in the form of one or several series of sections, each section being shorter than the entire circumference of the respective part of the cup.

10

7. Cup according to claim 6, characterized in that said sections are separated by gaps (8) extending longitudinally, i.e. in parallel with the axis of the cylindrical part, through the entire beaded part.

15

FIG 2

FIG 1

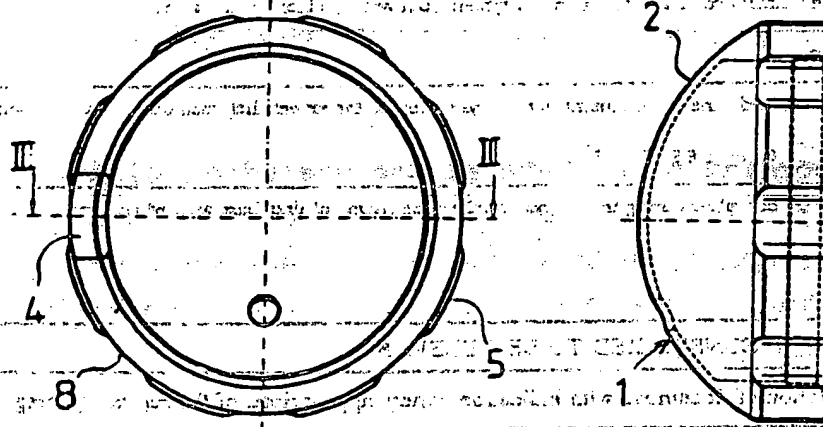


FIG 3

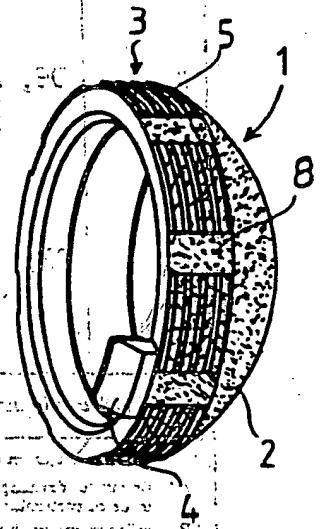
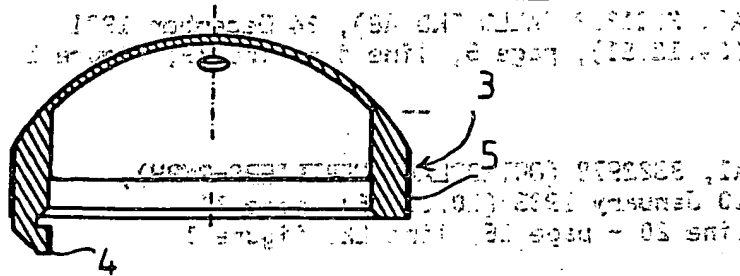


FIG 4

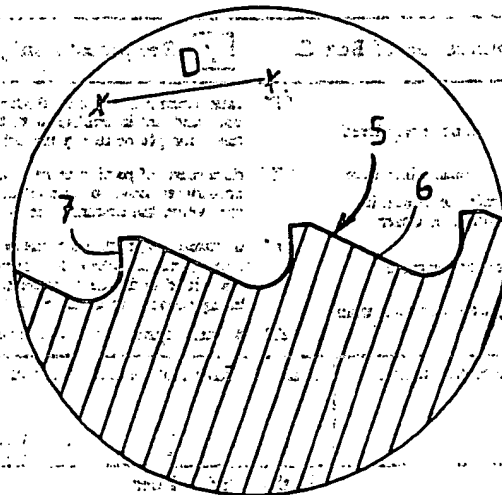


FIG 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 94/01233

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A61F 2/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP, A2, 0575102 (SMITH & NEPHEW RICHARDS INC.), 22 December 1993 (22.12.93), page 4, line 14 - line 45, figures 1,5,7	1-2,5
X	DE, A1, 3101333 (ALLO PRO AG), 24 December 1981 (24.12.81), page 5, line 4 - line 19, figure 1	1-2,4-6
X	DE, A1, 3322978 (ORTHOPLANT VERTRIEBS-GMBH), 10 January 1985 (10.01.85), page 14, line 20 - page 16, line 22, figure 1	1-2,4-7
A	DE, A1, 2645101 (STAATLICHE PORZELLAN-MANUFAKTUR BERLIN, (KPM)), 6 April 1978 (06.04.78), figure 4	1,4-7

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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C (Continuation): DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>US, A, 4164794 (MYRON SPECTOR ET AL), 21 August 1979 (21.08.79), figure 1</p> <p>FIG. 1</p> <p>100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000</p>	1,5

INTERNATIONAL SEARCH REPORT

Information on patent family members

25/02/95

International application No.

PCT/SE 94/01233

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DE-A1- 2645101	06/04/78	NONE	
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		CH-A- 621059	15/01/81
		DE-A, C- 2816072	19/10/78
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		JP-C- 1238577	31/10/84
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